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Does U.S. Food Aid Crowdout Local Food Production?*

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The coöccurrence of confounding events, such as natural disasters, obscures the effect U.S. food aid has on cereal-grain production in recipient countries. To clarify the relationship, this paper instruments for food aid with an interaction of U.S. wheat stocks, U.S. military assistance, and alliance with the U.S. Analysis of data from 118 countries over 45 years (1961–2006) reveals that doubling U.S. food aid reduces cereal-grain production by 1.5%. In terms of calories, food aid crowds out local cereal production one for one. The impact is particularly significant for sub-Saharan Africa, low-income countries, and regular recipients of U.S. food aid.

Introduction

The most common criticism of U.S. food aid is that it crowds out the production of cereal grains in recipient countries (Schultz 1960; Maxwell and Singer 1979; C. B. Barrett and D. Maxwell 2007). Evidence supporting this critique, however, is meager (Tschirley, Donovan, and Weber 1996; Gelan 2007; Tadesse and Shively 2009). Empirical analysis is complicated by confounding events, such as natural disasters, that affect both food aid and production. Food aid sent in response to a disaster will be negatively correlated with cereal production because the disaster will cause cereal production to decline *and* cause the U.S. to send food aid. After the disaster ends, cereal-grain production will restart, and food aid delivered during the disaster will appear to be *positively* related to subsequent cereal production. Failure to address the "mechanical" relationship between food aid and production leads to biased estimates. Lavy (1990) and Barrett, Mohapatra, and Snyder (1999) fall prey to this source of bias by relying on time-series variation in a vector-autoregressive (VAR) model for identification. Abdulai, Barrett, and Hoddinott (2005) attempt to address this concern by conditioning on rainfall and disasters in a country-level fixed-effects VAR model for sub-Saharan Africa in 1970–2000. This control-variable approach, however, falls short if disaster affects production and food aid over multiple periods.

To address the issue, we employ an instrumental-variables strategy to study the causal effect of food aid on production in 118 recipient countries over the period of 1961–2006. We instrument for food aid receipts with a three-way interaction term of U.S. wheat stocks, U.S. military assistance, and the recipient country's alliance with the U.S. in the United Nations General Assembly (U.N.). This instrument significantly captures variation in the food aid variable, and the identification strategy provides unbiased and consistent estimates. We focus on U.S. in-kind cereal food aid given the dominant position of cereal aid over other categories of food aid commodities.

To answer the question, we have constructed a unique dataset of U.S. food aid shipments from 1961–2006 combined with agricultural production data from the Food and Agricultural Organization of the U.N. (FAO). Most country-level analyses use data from the World Food Programme (WFP), which are only available starting in 1970. To analyze the full impact of U.S. food aid we combine 1954–1971 country×commodity-level data that we digitized from the U.S. Department of Agriculture (1974), with data from the Foreign Agricultural Service of the U.S. Department of Agriculture covering 1972–2006. We combine our unique food aid data with FAO production data by reconciling the commodities in FAO production data with USDA food aid data to make sure that close substitutes are included at each aggregation level. That is to say, cereals in the production and food aid data contain the same (or equivalent) types of grains. This allows us to provide more precise estimations of the impacts. Very few studies attempt to make production and food aid data comparable, and thus our reclassification approach provides a new angle from which to process production and food aid data for future studies.

We find that U.S. cereal aid reduces cereal production in recipient countries. If the U.S. doubled food aid, production in recipient countries would fall by 1.5% on average. In terms of food aid quantity, if the average amount of food aid were to double, food aid would increase by 70,832 metric tons (MT) and production in the recipient country would fall by 173,952 MT. It looks like one MT of U.S. food aid crowds out 2.45 MT of recipient country cereal grains, but if we look at it in terms of calories, this begins to make sense. Doubling food aid means an increase of 234,499 kcal in food aid and a decrease of 248,000 kcal of domestic production in the recipient country. In terms of calories, the substitution in nearly one-for-one even though in terms of metric tons the substitution is 1:2.45, which suggests that high-quality food-aid grains substitute for low-quality cereals.

The disincentive effect is primarily driven by wheat and feed grains. This disincentive effect of food aid on production is particularly significant for sub-Saharan African countries, low-income countries, and regular recipients of U.S. food aid. However, this disincentive effect disappears when food aid is used for humanitarian needs. For policy-makers, it is important to be aware of heterogeneous effects since the focus of policy should be placed on the group of countries that are more likely to be adversely affected by food aid.

Our paper belongs in several branches of literature. First, our study adds to a body of literature that studies the impact of food aid on production. Although the concern regarding the disincentive effects of food aid arose in 1960, empirical evidence has been meager. Seevers (1968) used supply and demand elasticities along with plausible values for other variables in India in 1956-1957 and 1961-1962 and found food aid had disincentive effects on domestic production. Gelan (2007) used a computable general equilibrium model to conclude that eliminating in-kind food aid in Ethiopia would increase production by 2.2%. In spite of using a different identification strategy from previous studies, our study also supports the disincentive effects of food aid. The heterogeneous effects of food aid advances our understanding of the groups of countries that are more likely to experience disincentive effects.

The instrument used in our paper follows the same logic as the identification strategy used in the literature on impacts of foreign aid on economic outcomes. For example, Werker, Ahmed, and Cohen (2008) studied the effects of transfers from wealthy OPEC nations to their poorer Muslim allies. They interacted oil price with a binary indicator for Muslim recipient countries and used this interaction term as the instrument for foreign aid. Similar to Werker, Ahmed, and Cohen's approach, other papers (Nunn and Qian 2014b; Dreher and Langlotz 2015) constructed instruments by interacting one variable that varies across countries with the other variable that changes over time. Our instrument also captures cross-sectional variations in the endogenous variable by including time- and country-invariant components.

The rest of paper is organized as follows. Section II provides background of the U.S. food aid programs. Section III describes the methods, followed by the data descriptions. Section V covers the results, and VI summarizes findings and concludes with policy implications.

Background

The United States has become a primary food aid donor since enactment of the Agricultural Trade Development and Assistance Act (Public Law 480, or P.L. 480) on July 10, 1954. President John F. Kennedy referred to P.L.480 as the "Food for Peace Act" in 1961, but the name of P.L. 480 was not officially changed to the Food for Peace Act (FFPA) until passage of the 2008 farm bill. FFPA consists of the following four types of aid programs: Title I- Economic Assistance and Food Security, Title II-Emergency and Private Assistance, Title III-Food for Development, and Title V-Farmer-to-Farmer Program. Title I of the Food for Peace Act is administrated by the Foreign Agricultural Service of USDA, whereas Title II, Title III and Title V are operated by the United States Agency for International Development (USAID) (Schnepf 2015). Congress provides funding for the programs through annual and supplemental appropriations.

The purpose of Title I aid is to dispose of surplus cereals with the goals to reduce the U.S. government storage costs and expand the U.S. export market (Congress 1990). FFPA Title I programs are concessional credit sales of agricultural commodities provided by the U.S. government to developing countries. Title I aid is usually sold on credit or grant terms rather than freely distributed. That is to say, developing countries involved in Title I programs can finance their purchase from the Commodity Credit Corporations (CCC), which is managed by the USDA, through long-term and low-interest rate loans. The remaining titles are operated on a completely free basis. Title II of the Food for Peace Act is different from program aid because it is donated to countries exposed to large-scale disasters in order to meet humanitarian needs. Title III, Food for Development, provides free commodities to developing country governments that they generally sell to fund long-term economic development programs.

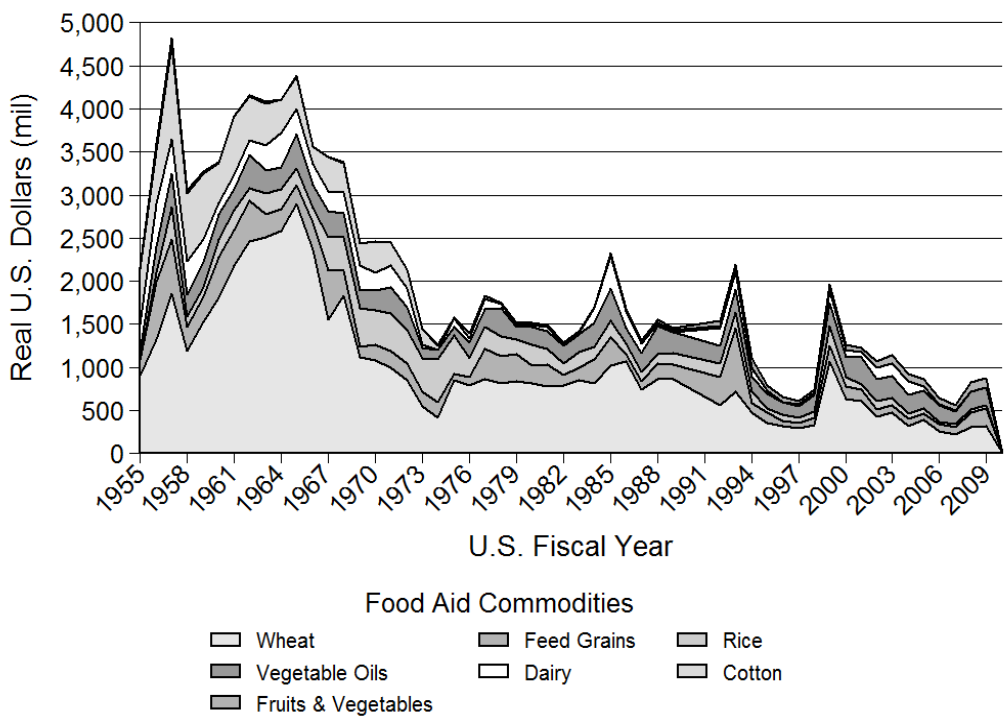
Title III programs ended in 1999. Title V, the Farmer-to-Farmer program (FtF), was initially authorized in the 1985 farm bill. The purpose of the Farmer-to-Farmer program is to enhance development in the agricultural sectors in developing countries through the provision of technical assistance to farmers and agricultural organizations.

Over the course of sixty years, the volume of different types of aid programs has varied in accordance with the variations in the objectives of the U.S. aid program. Title I food aid was predominant before the 1970s. After the mid-1970s, the amount of program aid was reduced due to a reduction in stocks, and was replaced by emergency aid, which emerged as the most prominent form of aid in the 1990s. The status of emergency aid was reinforced when the 1990 farm bill explicitly listed the promotion of food security as a primary objective of food aid. Aggregating the amount of in-kind food aid, Figure 1 demonstrates the trends over time for total U.S. food aid. U.S. food aid shipments dropped dramatically in the early 1970s because of a reduction in food stocks caused by the world food crisis. Then, U.S. food aid grew steadily and peaked in the early 1990s. Together with the drain in the cereal surpluses, food aid shipments fell to historical lows during the mid-1990s.

Cereal grains have accounted for 90.26% of all food aid commodities. They are undoubtedly the primary U.S. food aid commodity. Thus we focus on cereal aid when analyzing U.S. food aid. In addition to grains, the U.S. also has delivered six other categories of commodities. These include dairy and animal products, fruits, oilseeds, cotton, vegetables, and tobacco. The relative proportion of each of the primary commodities is shown in Figure 1. Among U.S. cereal aid, wheat is the primary donated crop, constituting 71.6% of donations. The second largest cereal group is feed grains. This group accounts for 19.08% of U.S. cereal aid.

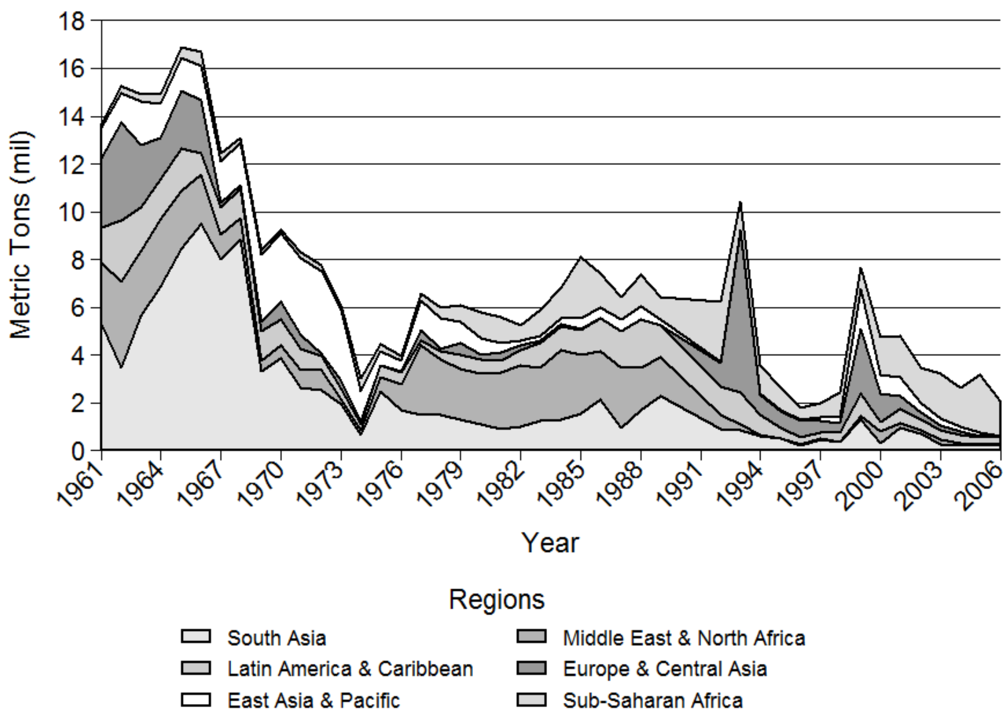
In addition, U.S. food aid shipments vary a great deal by regions and are closely aligned with U.S. political interests in particular regions. Figure 2 demonstrates the changes in the amount of aid delivered to six regions over time. In the 1960s and the beginning of the 1970s, the United States allocated considerable food aid to South Asia, where many countries were swinging back and forth between capitalism and communism. In 1973, the world food crisis erupted. African countries were hit badly and thus became recipients of U.S. food aid. In the mid-1970s, the U.S. shipped aid to Middle Eastern countries in response to the oil embargo, which began in 1973. The U.S. continued sending aid in the 1980s to Middle Eastern countries to claim its interest in these countries' natural resources. After the end of the Cold War, the U.S. escalated food aid shipments to Europe for the purpose of alleviating the tense relationships with the former Eastern Bloc countries. Since the late 1990s, most food aid has gone to sub-Saharan African countries, which suffer severely from a variety of natural disasters and chronic poverty. This trend corresponds with the fact that emergency aid outweighs other types of food aid since the 1990s.

Figure 1: Total Value of U.S. Food Aid (1955–2010)



Data Source: Food aid data are from the USDA. *Notes:* The value is in real U.S. dollars using a base year of 2005. The value of tobacco food aid is negligible, and thus we do not include tobacco on the graph. We also exclude the year 1990 and 1991 on the x-axis.

Figure 2: Total Quantity of U.S. Food Aid by Region (1961–2006)



Data Source: The regional classification is from the World Bank. Food aid data are from the USDA.
Notes: We exclude the year 1990 and 1991 on the x-axis.

Identification Strategy

Given our interest in studying the impact of food aid on food production, we use the following regression specification:

$$Y_{i,t} = \alpha + \beta Aid_{i,t-1} + \lambda X_{i,t-2} + \tau_i + \varphi_t + \epsilon_{i,t} \tag{1}$$

where $Y_{i,t}$ is the quantity of food production measured in metric tons (MT), $Aid_{i,t-1}$ is the quantity of food aid in MT at the period $t-1$, $X_{i,t-2}$ represents a vector of exogenous variables affecting food production, τ_i is a country fixed effect, φ_t is the time fixed effect, and $\epsilon_{i,t}$ is the idiosyncratic error term. A full list of the explanatory variables is discussed in the data section and shown in Appendix Table A1. In addition, we take the logarithm of food production and food aid to make the distributions less skewed. Note that a value of one is added to food aid before taking the logarithm to preserve observations.

A concern surrounding reverse causality arises if the United States gives aid in response to production shocks in the developing countries. Considering the humanitarian-aid dimension of food aid, one expects food aid to increase when a country experiences a negative production shock. Indeed, Nunn and Qian (2014a) find that domestic food production in developing countries is negatively correlated with food aid receipts.

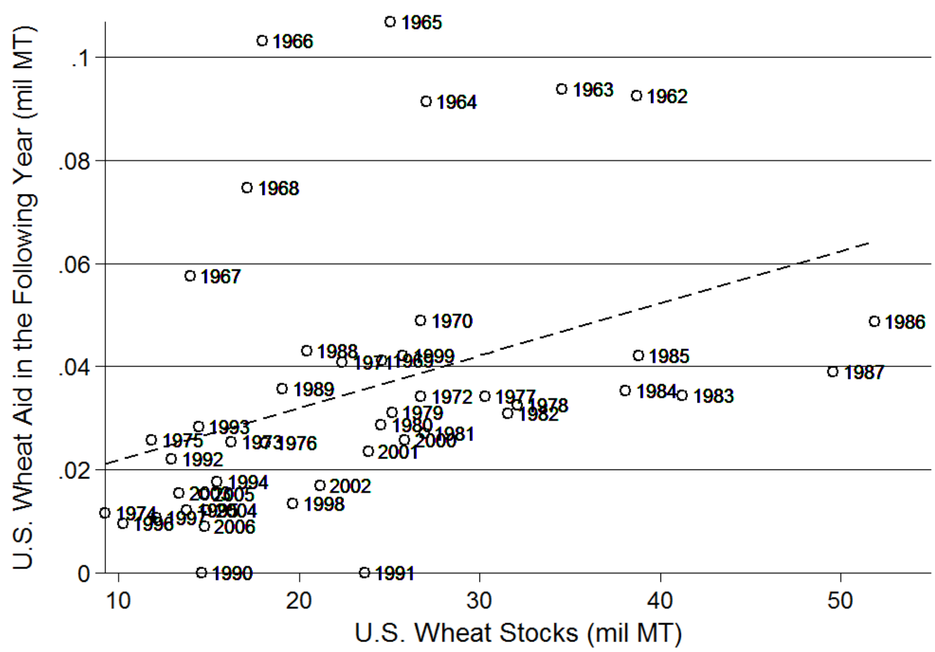
We address the potential bias due to the endogeneity of food aid by employing instrumental variables.[1] In this study, we instrument for food aid with a three-way interaction of U.S. wheat stocks, U.S. military assistance, and a measurement of a country' s alliance with the U.S. through its voting pattern in the U.N. in the preceding year. Since one of the explicitly stated objectives of the U.S. food aid program is to dispose of surplus, we assume higher U.S. wheat stocks in the preceding year would lead to a higher amount of U.S. wheat food aid in the following year. Figure 3 illustrates the positive relationships between lagged U.S. wheat stocks and U.S. wheat aid delivered in year *t*. Due to the dominant proportion of U.S. wheat aid over the U.S. food aid program, we also expect a larger amount of U.S. cereal food aid as a result of an increased amount of wheat aid.

Because U.S. wheat stocks vary over time but not across recipient countries, we interact U.S. wheat stocks with the following country-specific characteristics: U.S. military aid to the country and the country's voting pattern in the U.N. We expect that U.S. military aid is positively related to food aid flows. The bivariate coefficient is a strongly significant 0.22. This indicates that food aid is often used together with military aid to achieve national security objectives. In addition, B. C. Barrett and G. D. Maxwell (2006) argued that countries that have experienced heavy intervention by U.S. armies are more likely to receive food aid as a way to ease agitation. Furthermore, the United States tends to give food aid to its allied countries. Raschky and Schwindt (2009) also instrumented foreign aid with the voting patterns in the United Nations General Assembly. They argued that it is common for donor countries, such as the United States, to reward their political allies.

These variables are not only relevant but are also excludable, meaning that each component of the instrument affects production only through its influence on food aid. Lagged U.S. wheat production is a donor-country-based variable, and thus is

[1]The first stage of the 2SLS does not consider that the food aid variable is a corner solution. The consistency of 2SLS estimation, however, does not dependent on the correct specification in the first-stage (Kelejian, 1971). Wooldridge (2002) also provided an approach to address the issue. He suggested to use fitted probabilities from a first-stage Tobit model as an instrument for the endogenous variable. We follow Wooldridge's approach, and the results are the same as the conventional 2SLS results.

Figure 3: U.S. Wheat Stocks Versus U.S. Wheat Aid in the Following Year (1961–2006)



Data Source: Stock data are from the USDA-Farm Service Agency ($http://www.fsa.usda.gov/daco/wid/imb/cccinventory\_arch.htm$). Wheat aid data are from the USDA. *Notes:* The unit of the wheat inventory in its original source is bushel. We divide the total bushels by the conversion factor (36.744) to get wheat stocks in metric tons. Food aid data from 1990 and 1991 are unavailable.

considered exogenous. One may be concerned about the possibility that the U.S. may influence cereal production by delivering more non-food aid economic assistance to countries that are politically close. We address the concern by including U.S. non-food aid economic assistance in the regression to control for the influence of political alignment on production via its impact on other types of economic assistance. Thus, a country's voting pattern in the U.N. is also excludable conditional on other economic assistance. As for the third variable, the natural log of the total amount of U.S. military aid, it also affects domestic production only through its influence on U.S. food aid conditional on the explanatory variables. A potential concern is that the U.S. sends military aid to countries experiencing conflict, and conflict might affect cereal grain production. The United States, however, deploys military aid to support U.S. militarystrategic interests over the long run, instead of in response to outbreaks of conflict. For example, Greece and Turkey received large amounts of military aid during the 1960s because of the Truman Doctrine, although no conflict in these two countries broke out during the same period. The U.S. gave millions of dollars in military aid to countries threatened by Soviet communism and other anticommunist regimes throughout the world to develop alliances against the Soviet Union. To some extent, U.S. military aid is driven by American foreign policy and is not directly related to outbreaks of conflict. We also check the bivariate relationships between the existence of conflict and an indicator of receiving any amount of U.S. military aid. The insignificant coefficient with a large p-value (0.14) indicates that U.S. military aid is not significantly related to conflict. We include a dummy variable of conflict in the regression to capture any differential effects of U.S. military aid on production through the outbreaks of conflict. U.S. military aid is arguably excludable conditional on explanatory variables.

Data Description

This study uses a panel dataset consisting of 118 countries over the period 1961-2006. The pattern of the data is an unbalanced panel from 1961-2006 due to the dissolution and independence of several countries during this time period. The countries of interest are developing countries with income levels varying from upper-middle income, lower-middle income to low income levels, spreading out over six regions. These regions are East Asia and Pacific, Europe and Central Asia, Latin America and Caribbean, Middle East and North Africa, South Asia, and sub-Saharan Africa, based on the World Bank's regional classification. A full list of countries is shown in Appendix Table A2. We exclude high-income and small population countries based on the their status prior to the implementation of U.S. food aid programs in 1955.

The food aid data sets come from the USDA. We digitized the 1955-1973 food aid data from the USDA report "Agricultural Exports under Public Law 480" (U.S. Department of Agriculture 1974). Food aid data for 1971–1989 are from the USDA-Foreign Agricultural Service (FAS), and USAID provided the 1992–2006 data. The food aid variable measures the total quantity of food aid delivered from the U.S. to recipient countries. The mean quantity of U.S. cereal aid shipments is 70,832 MT as shown in Table 1.

Production data are from the Food and Agricultural Organization's statistical database (FAO-STAT). These data are supplied by governments through national publications, FAO questionnaires and international organizations and agencies. The average quantity of cereal production is 11,596,800 MT in Table 1. The data contain production information on primary products over the calendar year. If the harvest of crops takes place between years, production of a given commodity is allocated to the calendar year

Table 1: Summary Statistics

	count	mean	sd	min	max
U.S. Cereal Aid (MT)	4429	70832.15	321225.85	0	8489998
U.S. Cereal Aid per capita	4429	0.00	0.01	0	0
U.S. Cereal Aid(cal)	4429	2.34e+08	1.07e+09	0	2.82e+10
U.S. Cereal Aid(cal) per capita	4429	12.60	33.02	0	442
Cereal Production (MT)	4429	11596800.27	39866320.84	428	458395648
Cereal Production per capita	4429	0.24	0.23	0	2
Cereal Production (cal)	4429	3.60e+10	1.29e+11	1523680	1.53e+12
Cereal Production (cal) per capita	4429	737.74	749.84	0	5728
Deviation of Rain	4307	-0.07	175.09	-1143	1545
Population	4429	40078.79	132243.52	692	1313974
Disasters	4429	1.43	2.85	0	37
Conflict	4429	0.25	0.43	0	1
Openness Score	4065	60.27	38.84	1	623
Real GDP per capita	4065	4511.86	4771.24	306	56312
Democracy Score	4209	2.72	3.58	0	10
Arable Land (%total)	4429	0.16	0.14	0	1
Military Aid per capita	4429	2.86	16.38	0	403
Log(U.S. Military Aid)	4429	7.31	7.81	0	23
U.S. Economic Aid per capita	4429	5.47	14.99	0	327
Alignment	4149	0.24	0.15	0	1
FAO Wheat Producer Prices	2181	1.40e+09	1.61e+10	0	2.59e+11

Notes: An observation is a country and a year. The sample includes 118 recipient countries from 1961–2006.

in which most of harvest occurs. [2]

We also control for other variables in the regression, including precipitation, disasters, conflict, trade openness, GDP per capita, population, institutional democracy, arable land (% of total land of a country), and U.S. economic aid (net of U.S. food aid). Table 1 lists the summary statistics for these variables. In the analysis, the GDP per capita, population, and U.S. economic aid variables are log transformed. Appendix Table A1 displays the definition and data source for each variable.

The limitations of the data derive from the intrinsic nature of the data itself. A disadvantage of these data is that they only contain the total aggregated food aid data, and thus the accurate composition of Title I and Title II aid is unknown. The lack of

[2] Given that the FAOSTAT and USDA have different rules for standardizing and aggregating data, we re-classify FAO commodities by mapping the FAO commodity codes into the codes used in food aid data. The principle is that each FAO product code is assigned just one aid code at the lowest possible level of aggregation. Using this method allows FAO production data to have the same structure as food aid data.

this piece of information restricts us from exploring the differences in the impacts of various titles of food aid on production.

Results

Three-way Interaction Instrument

The first column of Table 2 shows the OLS estimates of the model in equation (1). We include a set of covariates as well as country and year fixed effects to account for omitted variable bias. The OLS estimate of the variable *log (U.S. cereal aid)* is -0.01 and is significant at the 5% significance level. The interpretation of the negative coefficient is ambiguous due to the presence of simultaneity bias in the regression. This negative coefficient might indicate that U.S. cereal aid reduces cereal production in recipient countries or that the U.S. gives more aid to countries that experience negative production shocks. To separate the two effects, we adopt an instrumental variables strategy.

Column 2 in Table 2 reports the findings of the two-stage least square (2SLS) estimates. We use a three-way interaction among the quantity of U.S. wheat stocks, the natural log of the dollar amount of U.S. military aid, and alignment with the U.S. in the U.N. in the preceding year as the instrument for the quantity of U.S. cereal aid. All of the regressions include baseline controls. First-stage and reduced-form results are reported in Appendix Table A3. The first stage Keibergen-Paap F-statistic is 23.07, well above the commonly used threshold of 10. The point estimate of the instrument in the first stage is 0.0099 (Column 1 of Appendix Table A3), and this is statistically significant at the 0.01 level of confidence. Consider the case of a country that received the sample mean amount of military aid of $7.2 measured in logarithm and had the mean U.N. voting score of 0.24 one year prior to receiving food aid. A 1,000 MT increase in U.S. cereal stocks would lead to a 17 MT ($7.2 \times 0.24 \times 0.0099 \times 1000$) increase in the amount of cereal aid received the following year.

The two stage least square estimate is shown in the second column of Table 2. The results support the hypothesis that cereal food aid negatively affects cereal production. The 2SLS estimate of the variable *log (U.S. cereal aid)* is -0.062 and is significant at the 1% level. This suggests that if the U.S. were to double cereal aid, cereal production in recipient countries would decrease by 6.2%.[3]

One limitation of measuring quantities of cereal aid in terms of metric tons is that there is no differentiation among different types of grains. In reality, one metric ton of wheat is worth more than one metric ton of rice from a nutritional perspective. This is

[3]Columns 3-5 of Appendix Table A3 show the results when we disaggregate cereal aid into three main types of grains, which are wheat, rice, and feed grains. The effects of cereal aid on production are primarily driven by wheat and feed grains.

Table 2: The Effect of U.S. Food Aid on Cereal Production in the Recipient Country

	(1) OLS	(2) 2SLS	(3) Calories	(4) 2SLS	(5) A-B	(6) A-B_Cal
Log(Cereal Aid)$_{t-1}$	-0.0100**	-0.062***	-0.032***	-0.023**	-0.015*	-0.0069*
	(0.00453)	(0.0169)	(0.0103)	(0.00913)	(0.00805)	(0.00404)
Log(US Economic Aid)$_{t-2}$	-0.0013	0.014***	0.012**	0.0054**	-0.000083	-0.00041
	(0.00231)	(0.00470)	(0.00487)	(0.00244)	(0.00159)	(0.00160)
Log(GDP per capita)$_{t-2}$	0.16**	-0.019	0.0041	-0.0039	0.049	0.055
	(0.0628)	(0.0822)	(0.0850)	(0.0398)	(0.0654)	(0.0636)
Log(Population)$_{t-1}$	0.97***	1.08***	1.09***	0.48***	0.46**	0.49**
	(0.227)	(0.199)	(0.194)	(0.0994)	(0.211)	(0.213)
Deviation Precip	0.00017***	0.00013***	0.00014***	0.00013***	0.00016***	0.00016***
	(0.0000465)	(0.0000444)	(0.0000450)	(0.0000278)	(0.0000247)	(0.0000248)
Disasters$_{t-2}$	0.0048	0.0047	0.0043	0.00084	0.00093	0.00086
	(0.00423)	(0.00543)	(0.00554)	(0.00259)	(0.00299)	(0.00302)
Conflict$_{t-2}$	-0.051*	-0.073**	-0.073**	-0.042**	-0.0032	-0.0015
	(0.0294)	(0.0343)	(0.0340)	(0.0165)	(0.0172)	(0.0174)
Democracy Score$_{t-2}$	0.0089	0.0091	0.0077	0.0039	-0.0079**	-0.0078**
	(0.00655)	(0.00697)	(0.00695)	(0.00313)	(0.00383)	(0.00387)
Openness Score$_{t-2}$	-0.00035	-0.00030	-0.00031	-0.000092	0.00014	0.00012
	(0.000522)	(0.000471)	(0.000474)	(0.000247)	(0.000366)	(0.000370)
Arable Land$_{t-2}$	0.77	1.72***	1.84***	0.66*	-0.055	-0.086
	(0.652)	(0.637)	(0.653)	(0.339)	(0.559)	(0.566)
Log(Cereal Production)$_{t-1}$				0.55***	0.14**	0.16**
				(0.0577)	(0.0649)	(0.0631)
Kleibergen-Paap F-statistic		23.07	21.49	20.36		
Observations	3629	3531	3531	3531	3406	3406

Significance levels: * 10 percent, ** 5 percent, *** 1 percent. Standard errors (in parentheses) clustered by country. *Notes:* An observation is a country and a year. The sample includes 118 recipient countries from 1961–2006. All regressions include country fixed effects and year fixed effects.

the case because wheat provides more calories than rice given the same quantities in metric tons. In order to examine the effects of cereal aid on production using caloric measurements, we use the FAO converter to transform the unit of aid from metric tons to calories.

Column 3 in Table 2 shows the estimates using caloric measurements, and the regression includes the above instrument and baseline controls. The magnitudes and significance levels for the exogenous independent variables are similar to those in the regression with the variables being measured in metric tons. However, the 2SLS estimate of the variable of interest, cereal aid in terms of calories during the previous year, is -0.032. This estimate is less than that (-0.062) under the specification of using metric tons as the unit. The coefficient remains statistically significant at the 1% confidence level. This result is consistent with the results measured in metric tons and implies that U.S. cereal food aid can lead to a reduction in cereal production during the following year in recipient countries.

Lagged Dependent Variable

In the previous discussion, we did not control for the lagged dependent variable in the regression. In reality, however, food production is persistent in a manner such that last year's production is correlated with this year's food production. This is usually the case because many factors, such as droughts and the soil quality, may last more than one year and affect production persistently. Year-end stocks of grains may have an impact on the food market in the following year. In addition, the persistence of food production is likely due to the local crop rotation system, which involves changes in the planting of certain crops over the years.

To incorporate this fact into the model, we add the one-year lagged cereal production on the right-hand side of the regression. Columns 4-6 of Table 2 show the estimates using the instrumental variable method with country and year fixed effects. The fourth column of Table 2 shows that the 2SLS estimate of the variable *cereal aid* is still significantly negative, but the magnitude of the coefficient is smaller than that without controlling for the lagged dependent variable. Considering one-year lagged production, doubling U.S. cereal food aid leads to a 2.3% decrease in cereal production for the following year. The estimate of the lagged dependent variable is 0.55, which is statistically significant at the 1% level. The positive sign of this estimate confirms the hypothesis that the previous year's production positively affects the current year's production.

However, controlling for the lagged dependent variable in a fixed effect model introduces the Nickell Bias in the reduced form, which arises because the demeaning process or the first-difference process creates correlations between regressors and the error term. To address the Nickell Bias, we use the Arellano-Bond method. The results are shown in Column 5 of Table 2. More specifically, we use the second lag of the dependent variable as the instrument for the one-year lagged dependent variable. We do this because the AR (2) statistic is insignificant, which indicates that there is no autocorrelation between the error term in t and in $t-2$. The coefficient of the lagged dependent variable decreases to 0.14, although the estimate is statistically significant. The estimate of the variable food aid is -0.015, which is slightly smaller than the estimate reported in column 3 in terms of magnitude. Column 6 of Table 2 shows the estimates of variables as measured in calories. Cereal aid is still negatively related to cereal production in the following year, and other estimates are similar to estimates in the regression with metric tons as the unit of measure in Column 5, although the magnitude of cereal aid reduces to -0.0069. This indicates that recipient countries tend to reduce production for relatively low-calorie crops while receiving high-calorie cereal aid from the U.S.

In sum, the effects of cereal aid on production remain significantly negative under all specifications, although the magnitudes of the coefficient differ slightly depending on whether or not we control for the lagged dependent variable. When we control for the lagged dependent variable in the regression, we are less likely to have omitted variable bias. We thus consider the Arellano-Bond model with variables measured in terms of metric tons as the optimum specification so far. The coefficient of -0.015 means that, when the U.S. doubles food aid, food aid increases by 70,832 MT and production declines by 173,952 MT. Alternatively, when we interpret the impact in terms of kilo-calories (kcal), an increase in the amount of U.S. food aid by the mean value of 234,499 kcal results in an average reduction in production of 248,400 kcal. The 1:2.45 substitution rate for the quantity and one-for-one substitution for calories suggests that high-quality U.S. grains are substituted for low-quality, locally produced cereal grains.

Validity of The Instrument

One concern regarding the validity of the instrument arises due to the ambiguity in the time lag between sufficient stocks and food aid shipments. When using the current instrument, we assume that the U.S. would ship more food aid during the current year if stocks in the last year were sufficient. This assumption is fairly strong. It is possible that stocks two years ago have effects on this year's food aid shipments, or this year's wheat stocks have contemporaneous influence on food aid shipments. In order to test the sensitivity of the choice of the lags with respect to the results, Columns 1-2 of Table 3 show the first-stage estimates when the variable *wheat stocks* is lagged by one and three years. The other two components of the instrument still have two-year lags. The results show that the instrument is significant in the first-stage under all two circumstances. Although the assumption that food aid is positively related to last year's wheat stocks is restrictive, relaxing this assumption does not change the significance of the instrument.[4]

In addition, Column 3 of Table 3 provides the first-stage estimates when we replace U.S. wheat stocks with feed grain stocks. The new instrument is also significant in the first stage. The significance is not surprising because feed grain aid constitutes the second largest type of grains delivered as food aid, exceeded only by wheat. Together with military aid and voting similarity scores, variations in feed grain stocks can capture variations in cereal food aid as well. Given that the first stage F statistic of the new instrument is smaller than the F statistic of the equation that uses wheat stocks as one component of the instrument, we prefer to use the instrument that includes wheat stocks.[5]

As a falsification test, we use *future* wheat stocks, military aid, and U.N. voting alignment, i.e., periods t and $t+1$, to instrument for past, i.e., $t-1$, cereal food aid deliveries. The first-stage estimates, reported in columns 4 and 5 of Table 3 are insignificant. Meaning that the instrument cannot predict past food aid; in other words, it is the variance, not the persistence, that predicts food aid deliveries. We also run the Arellano-Bond model that regresses cereal production at t on food aid at $t+1$ and $t+2$. The regression includes the instrument and baseline controls, and the results are shown in columns 6 and 7. Again, we obtain insignificant coefficients of future food aid. The results support the validity of the instrument.

Heterogeneous Effects

We move on to study how the effects of food aid vary depending on a particular country's specific characteristics. We divide the countries into groups based on time frame, regions, income levels, and the average frequency of receiving U.S. food aid, and then examine the heterogeneous effects of food aid on production. We use the Arellano-Bond method and the results are shown in Table 4. In all categories, production in the previous year was positively related to production during the current year. In addition, for each group of characteristics, we generate a dummy variable, and interact the endogenous variable food aid with the dummy variable in order to represent the amount of aid received by this group. We interact the instrumental variable with the dummy variable to instrument for the new endogenous variable. An alternative method is to run the regression separately for each group. Using this approach may

[4]Appendix Table A5 shows that the significance of the 2SLS and Arellano-Bond estimates is not specific to the choice of the lags of the stocks variable.

[5]One may be still concerned about the excludability of military aid. Appendix Table A4 shows the regression results using the interaction term of U.S. wheat stocks and voting score in the U.N. as the instrument. The first stage Keibergen-Paap F-statistic reduces to 8.36, but the 2SLS and Arellano-Bond estimates of the food aid variable are similar to the results in Table 2.

Table 3: Validity of the Instrument

	(1) FirstS	(2) FirstS	(3) FirstS	(4) FirstS	(5) FirstS	(6) A-B	(7) A-B
Military Aid$_{t-2}\times$ Voting$_{t-2}\times$:							
Wheat Prod$_{t-1}$	0.0092***						
	(0.00219)						
Wheat Prod$_{t-3}$		0.0086***					
		(0.00196)					
FeedGrainsProd$_{t-2}$			0.018***				
			(0.00516)				
Instrument$_t$				0.0055			
				(0.00500)			
Instrument$_{t+1}$					0.0030		
					(0.00494)		
Log(Cereal Aid)$_{t+1}$						-0.013	
						(0.00802)	
Log(Cereal Aid)$_{t+2}$							-0.012
							(0.00963)
Log(Cereal Prod)$_{t-1}$	-1.11***	-1.13***	-1.18***	-1.18***	-1.14***	0.15**	0.16**
	(0.419)	(0.414)	(0.426)	(0.433)	(0.430)	(0.0659)	(0.0702)
Log(Population)$_{t-1}$	2.64**	2.73**	2.67**	2.25*	1.65	0.32	0.13
	(1.236)	(1.176)	(1.270)	(1.344)	(1.413)	(0.211)	(0.228)
Deviation Precip	-0.00036	-0.00032	-0.00040	-0.00023	-0.00034	0.00016***	0.00016***
	(0.000279)	(0.000277)	(0.000283)	(0.000285)	(0.000275)	(0.0000247)	(0.0000257)
Disasters$_{t-2}$	0.048	0.052	0.031	0.058	0.050	0.00070	0.0031
	(0.0462)	(0.0447)	(0.0466)	(0.0448)	(0.0446)	(0.00309)	(0.00321)
Conflict$_{t-2}$	-0.093	-0.094	-0.037	-0.13	-0.10	0.0057	-0.0041
	(0.306)	(0.306)	(0.318)	(0.317)	(0.321)	(0.0171)	(0.0176)
Openness Score$_{t-2}$	0.0012	0.0020	0.00089	-0.00087	-0.0018	-0.000060	0.000022
	(0.00360)	(0.00371)	(0.00359)	(0.00342)	(0.00329)	(0.000370)	(0.000376)
Log(GDP per capita)$_{t-2}$	-2.92***	-2.82***	-2.89***	-2.92***	-3.08***	0.097	0.12*
	(0.614)	(0.585)	(0.627)	(0.620)	(0.644)	(0.0608)	(0.0646)
Arable Land $_{t-2}$	18.9***	18.4***	18.8***	20.4***	21.8***	-0.090	-0.21
	(5.554)	(5.344)	(5.551)	(6.100)	(6.307)	(0.565)	(0.591)
Log(Economic Aid)$_{t-2}$	0.21***	0.21***	0.22***	0.22***	0.22***	-0.0013	-0.00091
	(0.0232)	(0.0228)	(0.0238)	(0.0237)	(0.0242)	(0.00152)	(0.00157)
Democracy Score$_{t-2}$	0.061	0.062	0.053	0.050	0.045	-0.0080**	-0.0073*
	(0.0592)	(0.0570)	(0.0610)	(0.0599)	(0.0600)	(0.00381)	(0.00388)
Observations	3531	3470	3454	3333	3232	3308	3208

Significance levels: * 10 percent, ** 5 percent, *** 1 percent. Standard errors (in parentheses) clustered by country. *Notes:* An observation is a country and a year. The sample includes 118 recipient countries from 1961–2006. All regressions include country fixed effects and year fixed effects.

result in the loss of observations, although it allows for variations in the effects of other explanatory variables on the outcome across the groups. To maintain the sample size, we report the results of regressions that include dummy variables.[6]

The estimates in the first column of Table 4 reveal the effects of food aid on production prior to 1990. 1990 was a watershed year for the U.S. food aid program because the promotion of food security has been an explicit objective of food aid since 1990. Title II emergency food aid has been predominant since then, whereas the volume of Title I food aid decreased dramatically. The estimate of food aid before 1990 is -0.019 and is statistically significant. In conjunction with the point estimate of food aid (-0.015) during the whole sample period in Column 4 of Table 4, it can be inferred that the negative effect of food aid on production occurred during the years prior to 1990, when Title I food aid outweighed Title II food aid. The results make sense and can be supported by our identification strategy since the instruments, especially U.S. wheat stocks and U.S. military aid, were significantly related to food aid allocation before 1990.

The estimates of Column 2 demonstrate the heterogeneous effects of food aid on production across regions. The regression also includes regional dummy variables. The results show that food aid exerts significantly negative effects on production in sub-Saharan Africa (SSA). When we divide countries into three groups based on their income levels, estimates in Column 3 show that disincentive effects of aid exist for low-income countries. The results are consistent with the findings for regions because most SSA countries are in the low-income category.

Finally, we check whether the effects of food aid on production differ between regular and irregular food recipient countries. We assign the value one to a country in a particular year if the country receives any amount of cereal aid. Based on the mean of the aid indicator during the entire time period, a country is categorized as a regular recipient country if the mean of the aid indicator is above the median (0.65). Otherwise, the country is an irregular recipient country. Column 4 shows that food aid has a disincentive effect on production in regular recipient countries. The point estimate is -0.017, meaning that a 100% increase in U.S. cereal food aid could lead to a 1.7% reduction in cereal production in regular recipient countries compared with irregular recipient countries. The results are in accordance with our expectations since regular recipient countries receive food aid more frequently, and are more likely to experience the effects of food aid if there are any. For irregular recipient countries, untimely and uncertain food aid flows may not be sufficient to persuade farmers to change production behavior.

[6] We also use the second approach to study heterogeneous effects. Heterogeneous effects are robust under both methods.

Table 4: Heterogeneous Effects of Food aid on Production

Log(Cereal Aid)$_{t-1}$ $\times$:	(1) Pre-1990	(2) By Region	(3) Income Classification	(4) Propensity of Receiving Aid
Before 1990	-0.019**			
	(0.00792)			
East Asia & Pacific		-0.0029		
		(0.0276)		
Europe & Central Asia		0.0071		
		(0.0272)		
Latin America & Caribbean		-0.0074		
		(0.0218)		
Middle East & N. Africa		-0.014		
		(0.0234)		
South America		-0.039		
		(0.0261)		
Sub-Saharan Africa		-0.025*		
		(0.0129)		
Low Income			-0.021*	
			(0.0126)	
Lower-Middle Income			-0.012	
			(0.0125)	
Upper-Middle Income			0.0036	
			(0.0246)	
Regular Recipient				-0.017*
				(0.0101)
Log(Cereals Production)$_{t-1}$	0.12*	0.14**	0.13*	0.15**
	(0.0633)	(0.0672)	(0.0677)	(0.0655)
Log(US Economic Aid)$_{t-2}$	0.00025	-0.00054	-0.00045	-0.00037
	(0.00157)	(0.00174)	(0.00167)	(0.00156)
Log(GDP per capita)$_{t-2}$	0.047	0.049	0.057	0.075
	(0.0632)	(0.0716)	(0.0662)	(0.0620)
Log(Population)$_{t-1}$	0.48**	0.47**	0.48**	0.44**
	(0.208)	(0.222)	(0.211)	(0.211)
Deviation Precip	0.00016***	0.00017***	0.00016***	0.00016***
	(0.0000243)	(0.0000255)	(0.0000251)	(0.0000247)
Disasters$_{t-2}$	0.0012	0.000052	0.00054	0.0014
	(0.00294)	(0.00314)	(0.00302)	(0.00300)
Conflict$_{t-2}$	-0.0038	-0.0086	-0.0014	-0.0022
	(0.0169)	(0.0191)	(0.0174)	(0.0172)
Democracy Score$_{t-2}$	-0.0070*	-0.0077*	-0.0080**	-0.0076**
	(0.00377)	(0.00405)	(0.00383)	(0.00382)
Openness Score$_{t-2}$	0.00012	0.00014	0.00020	0.00015
	(0.000359)	(0.000389)	(0.000372)	(0.000366)
Arable Land$_{t-2}$	-0.11	-0.18	-0.11	-0.11
	(0.550)	(0.598)	(0.562)	(0.560)
Observations	3406	3406	3406	3406

Significance levels: * 10 percent, ** 5 percent, *** 1 percent. Standard errors (in parentheses) clustered by country. *Notes:* An observation is a country and a year. The sample includes 118 recipient countries from 1961–2006. All regressions include country fixed effects and year fixed effects.

Robustness and Other Tests

This section evaluates some other possible scenarios that might confound the interpretation of the results. We also exclude ”outliers”, and check the robustness of the results for different sets of countries.

To determine whether the provision of U.S. cereal aid affects the amount of cereal aid from non-U.S. donors, we regress cereal aid from non-U.S. donors on U.S. cereal aid. The first column of Table 5 displays the 2SLS estimates. The significantly positive coefficient of U.S. cereal aid suggests that we could not find sufficient evidence to support the crowding-out effects of U.S. cereal aid on cereal aid from other donors. On the contrary, the point estimate of 0.4 indicates that other donors are likely to increase cereal aid donations when the U.S. provides more food aid.

Table 5: Robustness Tests

	(1) Non-U.S. Cereal Aid	(2) No Russia	(3) No Vietnam
Log(Cereal Aid)$_{t-1}$	0.40**	-0.014*	-0.015*
	(0.16)	(0.0078)	(0.0080)
Log(US Economic Aid)$_{t-2}$	-0.044	-0.000079	-0.000083
	(0.041)	(0.0016)	(0.0016)
Log(GDP per capita)$_{t-2}$	-0.31	0.047	0.049
	(0.79)	(0.065)	(0.065)
Log(Population)$_{t-1}$	1.52	0.47**	0.46**
	(1.35)	(0.21)	(0.21)
Deviation Precip	-0.00022	0.00016***	0.00016***
	(0.00031)	(0.000024)	(0.000025)
Disasters$_{t-2}$	0.060	0.00014	0.00093
	(0.077)	(0.0030)	(0.0030)
Conflict$_{t-2}$	0.40*	-0.0013	-0.0032
	(0.23)	(0.017)	(0.017)
Democracy Score$_{t-2}$	0.071	-0.0076**	-0.0079**
	(0.047)	(0.0038)	(0.0038)
Openness Score$_{t-2}$	-0.012***	0.00014	0.00014
	(0.0039)	(0.00036)	(0.00037)
Arable Land$_{t-2}$	0.62	-0.064	-0.055
	(6.16)	(0.55)	(0.56)
Log(Cereal Production)$_{t-1}$		0.13*	0.14**
		(0.065)	(0.065)
Observations	3531	3394	3406

Significance levels: * 10 percent, ** 5 percent, *** 1 percent. Standard errors (in parentheses) clustered by country. *Notes:* An observation is a country and a year. The sample includes 118 recipient countries from 1961–2006. All regressions include country fixed effects and year fixed effects.

In addition, it is possible that cereal food aid may drive farmers away from cereal production due to distortions in the market. Instead of producing cereals, farmers may produce additional grain substitutes. However, we cannot find evidence that farmers change cereal production to other types of production in response to the provision of cereal aid. Table 6 displays the effects of U.S. cereal aid on production of dairy animal products, fruits, vegetables, oilseeds, tobacco, and cotton respectively. The model is the Arellano-Bond estimation. The estimate of cereal aid is insignificant, whereas the lagged dependent variable is significant in all regressions. We also expect to observe insignificant results due to the small amount of cereal aid compared to the production level. Even if some farmers were to increase their production of other commodities, such an increase would be too negligible to exert any significant effects on production.

The second and third columns of Table 5 report the Arellano-Bond estimates while excluding Russia and South Vietnam, respectively. Russia and South Vietnam can be categorized as outliers. Russia received huge amounts of cereal aid right after the dissolution of the Soviet Union. As regards South Vietnam, that country received large amounts of U.S. military aid but was not allied with the U.S. The estimates show that excluding these two countries generates very similar results as using the model that includes the full observations (Column 5 of Table 2). These tests ensure that our results are not sensitive to outliers.

Mechanism

We now study the mechanism of the disincentive effect of food aid on production; that is to explore through which channels that food aid could decrease production. The first hypothesis is the price effect. An inflow of food aid is very likely to reduce domestic price, thereby decreasing production. We test this hypothesis by regressing wheat producer prices on cereal aid in the instrumental variable model with time and country fixed effects. We measure producer prices in logs to make the distributions less skewed. Producer prices refer to real U.S. dollars at the base year of 2005 for one metric ton of product. The number of observations in the regression is only 1,903, which accounts for roughly half of the total number of observations. The loss of observations is due to the limited availability of price data. We do not find significant effects of food aid on prices, and the results are shown in the first column of Table 7. When we examine the impact of cereal aid on wheat prices for low income countries before 1990, Column 2 shows a negative coefficient of -0.017 and significant at the 10% level. This indicates that food aid might reduce wheat producer prices for low-income countries prior to 1990. However, the limited number of observations requires additional caution when interpreting the results.

Several reasons contribute to the insignificance of the price effect. First, producer price data are of poor quality. The FAO collects farm-gate prices (producer prices)

Table 6: The Effect of U.S. Cereal Aid on Production of Grain Substitutes

	(1) Dairy	(2) Fruits	(3) Vegetables	(4) Oilseeds	(5) Tobacco	(6) Cotton
Log(Cereal Aid)$_{t-1}$	-0.0028	-0.0026	-0.00071	-0.018	0.0077	-0.0090
	(0.0024)	(0.0072)	(0.0043)	(0.011)	(0.014)	(0.015)
Log(US Economic Aid)$_{t-2}$	0.00016	-0.0011	-0.00035	-0.00086	0.00028	0.0028
	(0.00048)	(0.0012)	(0.00084)	(0.0022)	(0.0027)	(0.0029)
Log(GDP per capita)$_{t-2}$	-0.097***	0.042	-0.043	-0.079	0.039	-0.24**
	(0.019)	(0.044)	(0.033)	(0.080)	(0.098)	(0.11)
Log(Population)$_{t-1}$	0.010	0.18	0.070	-0.26	0.51	0.64
	(0.094)	(0.15)	(0.17)	(0.25)	(0.41)	(0.40)
Deviation Precip	0.0000080	0.000012	0.000044***	0.000049	-0.000023	-0.000017
	(0.0000073)	(0.000019)	(0.000014)	(0.000033)	(0.000041)	(0.000044)
Disasters$_{t-2}$	0.0013	0.0027	0.000098	-0.00019	-0.0072	-0.0035
	(0.00090)	(0.0023)	(0.0016)	(0.0041)	(0.0051)	(0.0055)
Conflict$_{t-2}$	-0.0089*	0.0010	-0.021**	-0.0076	0.0069	-0.013
	(0.0052)	(0.013)	(0.0095)	(0.024)	(0.029)	(0.032)
Democracy Score$_{t-2}$	-0.0017	-0.00066	-0.0021	-0.0062	-0.019***	-0.0077
	(0.0011)	(0.0029)	(0.0021)	(0.0053)	(0.0066)	(0.0073)
Openness Score$_{t-2}$	-0.000089	-0.00024	-0.000086	-0.00063	0.00012	-0.0028***
	(0.00011)	(0.00028)	(0.00020)	(0.00050)	(0.00063)	(0.00068)
Arable Land$_{t-2}$	-0.0057	-1.15**	0.27	1.22	0.95	-0.63
	(0.17)	(0.45)	(0.30)	(0.77)	(0.97)	(1.03)
Log(Dairy Prod)$_{t-1}$	0.76***					
	(0.087)					
Log(Fruits Prod)$_{t-1}$		0.81***				
		(0.13)				
Log(Vegetables Prod)$_{t-1}$			0.51***			
			(0.14)			
Log(Oilseeds Prod)$_{t-1}$				0.55***		
				(0.13)		
Log(Tobacco Prod)$_{t-1}$					0.48***	
					(0.18)	
Log(Cotton Prod)$_{t-1}$						0.49***
						(0.14)
Observations	3406	3406	3406	3406	3406	3406

Significance levels: * 10 percent, ** 5 percent, *** 1 percent. Standard errors (in parentheses) clustered by country. *Notes:* An observation is a country and a year. The sample includes 118 recipient countries from 1961–2006. All regressions include country fixed effects and year fixed effects.

Table 7: The Effect of U.S. Food Aid on Domestic Wheat Prices

	(1) Log(Wheat Producer Prices)	(2) Low Income Countries Before1990
Log(Cereal Aid)$_{t-1}$	-0.14	-0.017*
	(0.222)	(0.0097)
Log(US Economic Aid)$_{t-2}$	-0.17	0.047
	(0.245)	(0.101)
Log(GDP per capita)$_{t-2}$	3.63	-1.34
	(4.521)	(1.700)
Log(Population)$_{t-1}$	4.93*	0.66
	(2.520)	(3.073)
Deviation Precip	-0.00025	0.00031
	(0.000571)	(0.000904)
Disasters$_{t-2}$	-0.048	-0.088
	(0.113)	(0.115)
Conflict$_{t-2}$	-0.84	-0.98*
	(0.641)	(0.595)
Democracy Score$_{t-2}$	-0.13	0.037
	(0.164)	(0.0375)
Openness Score$_{t-2}$	-0.0047	-0.0065
	(0.0155)	(0.0131)
Arable Land$_{t-2}$	-9.78	13.6
	(21.71)	(20.94)
Observations	1903	347

Significance levels: * 10 percent, ** 5 percent, *** 1 percent. Standard errors (in parentheses) clustered by country. *Notes:* An observation is a country and a year. The sample includes 118 recipient countries from 1961–2006. All regressions include country fixed effects and year fixed effects. The results are 2SLS estimates.

by sending out annual questionnaires to local farmers. The isolation of some developing countries from the outside world, either due to poor road infrastructure or intra-conflict, may prevent researchers from collecting data. In addition, countries' response rates are low. For example, the FAO's report shows that the average response rate for Africa during 2002-2007 was 29% (FAO 2007). Developing countries also sometimes provide prices in non-standard quantities or provide no information on conversion factors to the metric system (FAO 2007). This compromises the quality of producer price data. Thus, the inability to find any significant effects on price using our data does not necessarily imply the nonexistence of changes in price. Furthermore, governments in some developing countries implement price stabilization policies in response to the arrival of food aid in the local market. Bezuneh, Deaton, and Zuhair (2003) found that stabilization of prices alleviated price fluctuations caused by food aid, and reduced the adverse impacts of food aid on the local market in Tunisia. In other places, governments establish a series of policies to support local farmers, such as establishing a price floor for crops or distributing subsidies to farmers. With the implementation of price stabilization or price support policies, local producer prices cannot accurately reflect the market conditions in recipient countries, and thus it would be problematic to use FAO producer prices to study the price effect.

In addition to the price channel, food aid may decrease food production through its impact on government actions. The availability of food aid may give policy-makers excuses to postpone reforms in agriculture. Food aid simply disguises recipient countries' own shortcomings in food provision. Instead of investing in the agricultural sector, governments invest in other areas, such as urbanization. In Africa, the rate of urbanization increased from 15% in 1960 to 40% in 2010, making urbanization the main policy narrative (Habitat 2010). In Nigeria, Rakodi (1997) estimated that 80% of investments spent on urban-area development instead of agricultural development. If food aid resulted in a hesitation in essential agricultural reforms or a shift in the investment priority away from agriculture, production would be expected to decrease.

Discussion and Conclusion

U.S. food aid is an important tool to alleviate hunger and promote food security. However, many researchers have expressed concerns over the disincentive effects of food aid on production. Many studies have empirically tested whether food aid depresses local agricultural production using market-level data, but their results vary widely depending on the characteristics of the country as well as the time period in their studies. In spite of the rigorous design of the models, these micro-level studies lack external validity, and the results are restricted to a given setting, including geographic location, cultural context, and demographic characteristics. Undoubtedly this casts a shadow on their power to address policy questions.

This paper studies the impacts of food aid on production using a dataset with coverage of 118 developing countries from 1961–2006. We use ab instrumental variables approach as the identification strategy. The results show that U.S. cereal food aid depresses cereal production in recipient countries. This negative relationship still holds when we include the one-year lagged dependent variable and run the regression using the Arellano-Bond approach. Food aid may decrease production through its influence on price or through the changes in government actions. Due to limitations of the data, we cannot pinpoint the mechanism of action. Further research is necessary to identify channels through which food aid affects production.

Regarding the magnitude of the effect, the coefficient of -0.015 in the AB model indicates that if the U.S. doubled food aid shipments, production in the recipient countries would decrease by 1.5% on average. This magnitude is similar to the effect found in the previous studies. Seevers (1968) found that a 100% increase in food aid to India would cause 7.9% drop in local food prices, and thus lead to a 2% decrease in domestic production. Gelan (2007) concluded with a 2.2% increase in production in absence of in-kind food aid to Ethiopia. In spite of small differences in the magnitude of these estimates, our study supports the disincentive effects of food aid, and this finding is not subject to a particular method.

In addition, we find that the magnitude of the disincentive effects is reduced when we change the measurement unit of production and food aid to calories from metric tons. A decrease in the magnitude of the coefficient indicates that recipient countries, which receive aid in the form of high-calorie grains from the U.S., tend to reduce the production of grains that contain fewer calories relative to wheat, which is the primary type of U.S. cereal aid.

The results also show that the disincentive effects are significant for sub-Saharan African and low-income countries. In contrast to our findings, Abdulai, Barrett, and Hoddinott (2005) found that food aid did not depress food production in rural sub-Saharan African countries. Our analysis differs from Abdulai, Barrett, and Hoddinott (2005) in important ways. We include many more control variables (nine vs. three), and we examine the effects over a much longer period of time (1960–2006 vs. 1970–2000). Most importantly, we explicitly address simultaneity bias with plausibly exogenous instruments. The instruments employed by Abdulai, Barrett, and Hoddinott (2005) are invalid because they violate the exclusion restriction, by construction. For example, twice-lagged food aid instruments for once-lagged food aid, but twice-lagged food aid is also explicitly part of the model. Since it is not excluded from the model, it fails the exclusion restriction by construction. Consequently, the estimates in Abdulai, Barrett, and Hoddinott (2005) are biased.

As to whether or not food aid depresses production also depends on the frequency of a country receiving food aid. We find that the disincentive effects of food aid on production are significant for regular recipient countries but insignificant for irregular recipient countries. The results are in line with previous literature (Tadesse and Shively 2009) that found that the lack of certainty in the amount and delivery time of food aid makes any changes in production unwise. Lowder (2004) also considered the uncertainty of food aid shipments as one of the explanations for insignificant impacts of aid on production found in his paper.

In general, our results may deliver a pessimistic attitude towards the U.S. food aid program, but the heterogeneous effects of food aid convey more policy implications. The disincentive effects of food aid on production are particularly significant for sub-Saharan African countries, low-income countries, and regular recipients of U.S. food aid. This provides policy makers important information on groups of countries that are more likely to experience the disincentive effects, and food aid allocation to these groups should be thoroughly evaluated to minimize the adverse impacts.

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Appendix Tables (For Online Publication)

Table A1: A List of Controlled Variables

Controlled Variable	Data Source	Description
Precipitation	Climatic Research Unit at the Tyndall Centre (Mitchell et al., 2004); Terrestrial Air Temperature and Precipitation, Version 1.10 (Matsuura and Willmott, 2007)	Deviation from the mean annual precipitation in millimeters
Disaster	EM-DAT International Disaster Database from the Centre for Research on the Epidemiology of Disasters (CRED) in Belgium (Guha-Sapir, Below, and Hoyois, 2015)	Discrete variable
Conflict	UCDP-PRIO Armed Conflict Dataset (version 4-2014a) (Therese and Wallensteen, 2015)	Dummy variable
GDP per capita, Trade Openness, Population	Penn World Tables (version 6.3)	GDP per capita and openness variables are measured at 2005 U.S. dollars. The population variable is measured in thousands.
Institutional Democracy	Polity Data Archive, which was published by Gleditsch in the Department of Government at the University of Essex Colchester in 2003. We use the fourth version (2008).	Discrete variable
Arable Land	Food and Agriculture Organization of the United Nations	Percentage of arable land divided by total land areas
U.S. Economic Assistance	U.S. Overseas Loans and Grants (Greenbook), and which were prepared by USAID Economic Analysis and Data Services on March 28, 2014	Constant U.S. dollars using a base year of 2005
Producer Price	FAOSTAT (1991–2006); FAOSTAT Archive (1961–1991); Producer price data from Anderson and Valenzuela (2008)	The data are measured at real 2005 U.S. dollars. The unit is one metric ton of product.

Notes: These variables are the controlled variables in the regression except for the producer price variable. As regards the producer price data prior to 1991, the measurement is local currency provided by the FAOSTAT Archive. We convert the unit to U.S. dollars at the base year of 2005 using the exchange rate in the Penn World Tables.

Table A2: A List of Countries by Region

East Asia & Pacific	Europe & Central Asia	Latin America & Caribbean	Middle East & North Africa	South Asia	Sub-Saharan Africa
Cambodia	Albania	Argentina	Algeria	Afghanistan	Angola
China	Armenia (92–06)	Bolivia	Egypt	Bangladesh	Benin
Indonesia	Azerbaijan (92–06)	Brazil	Iran	India	Burkina Faso
Laos	Belarus (92–06)	Chile	Iraq	Nepal	Burundi
Malaysia	Bosnia Herzegovina (92–06)	Colombia	Lebanon	Pakistan	Cameroon
Myanmar	Bulgaria	Cuba	Libya	Sri Lanka	African Republic
North Korea	Croatia (92–06)	Dominican Republic	Morocco		Chad
Papua New Guinea	Czech Republic (93–06)	Ecuador	North Yemen (61–89)		Cote D'Ivoire
Philippines	Czechoslovakia (61–92)	El Salvador	Syria		DR Congo
South Korea	Estonia (92–06)	Guatemala	Tunisia		Eritrea (93–06)
South Vietnam (61–75)	Georgia (92–06)	Haiti	Yemen (90–06)		Ethiopia (93–06)
Thailand	Greece	Honduras			Ethiopia PDR (61–92)
Vietnam (76–06)	Hungary	Jamaica			Ghana
	Kazakhstan (92–06)	Mexico			Guinea
	Kyrgyzstan (92–06)	Nicaragua			Kenya
	Latvia (92–06)	Paraguay			Madagascar
	Lithuania (92–06)	Peru			Malawi
	Macedonia (92–06)	Puerto Rico			Mali
	Moldova (92–06)	Uruguay			Mauritania
	Montenegro (06)	Venezuela			Mozambique
	Poland				Niger
	Portugal				Nigeria
	Romania				Rwanda
	Russia (92–06)				Senegal
	Serbia (06)				Sierra Leone
	Serbia Montenegro (03–05)				Somalia
	Slovakia (93–06)				South Africa
	Slovenia (92–06)				Sudan
	Tajikistan (92–06)				Tanzania
	Turkey				Togo
	Turkmenistan (92–06)				Uganda
	Ukraine (92–06)				Zambia
	USSR (61–91)				Zimbabwe
	Uzbekistan (92–06)				
	Yugoslavia (61–92)				

Notes: Countries are divided into six groups based on the World Bank's regional classification. Years in the bracket indicate the time period that a country exists in our data. The year coverage for the remaining countries with no bracket is from 1961–2006.

Table A3: The First-Stage and Reduced Form Results

	(1) FirstS	(2) ReducedF	(3) Wheat	(4) Rice	(5) Feed Grains
Instrument	0.0099***	-0.00061***			
	(0.00207)	(0.000151)			
Log(Wheat Aid)$_{t-1}$			-0.080***		
			(0.0245)		
Log(Rice Aid)$_{t-1}$				0.76	
				(1.512)	
Log(Feed Grain Aid)$_{t-1}$					-0.077***
					(0.0238)
Log(US Economic Aid)$_{t-2}$	0.21***	0.0010	0.018***	-0.058	0.011**
	(0.0233)	(0.00217)	(0.00653)	(0.113)	(0.00468)
Log(GDP per capita)$_{t-2}$	-3.12***	0.17***	0.0047	0.86	0.023
	(0.623)	(0.0650)	(0.0853)	(1.446)	(0.0840)
Log(Population)$_{t-1}$	1.54	0.98***	1.19***	0.020	1.15***
	(1.288)	(0.225)	(0.243)	(1.806)	(0.265)
Deviation Precip	-0.00043	0.00016***	0.00018***	0.00042	0.00011**
	(0.000291)	(0.0000460)	(0.0000553)	(0.000504)	(0.0000451)
Disasters$_{t-2}$	0.045	0.0019	0.0019	0.026	0.0036
	(0.0465)	(0.00478)	(0.00573)	(0.0629)	(0.00620)
Conflict$_{t-2}$	-0.026	-0.071**	-0.078*	-0.31	-0.050
	(0.300)	(0.0300)	(0.0403)	(0.537)	(0.0330)
Democracy Score$_{t-2}$	0.057	0.0056	0.014	-0.055	0.0081
	(0.0595)	(0.00619)	(0.00878)	(0.114)	(0.00772)
Openness Score$_{t-2}$	0.0020	-0.00042	-0.00043	0.0026	0.00033
	(0.00376)	(0.000518)	(0.000532)	(0.00649)	(0.000599)
Arable Land$_{t-2}$	18.3***	0.59	1.30*	-6.47	1.47**
	(5.775)	(0.625)	(0.665)	(14.82)	(0.713)
Kleibergen-Paap F-statistic			14.68	0.30	21.42
Observations	3531	3531	3531	3531	3531

Significance levels: * 10 percent, ** 5 percent, *** 1 percent. Standard errors (in parentheses) clustered by country. *Notes:* An observation is a country and a year. The sample includes 118 recipient countries from 1961–2006. All regressions include country fixed effects and year fixed effects.

Table A4: The Effect of U.S. Food Aid on Cereal Production in the Recipient Country Using Wheat Stocks × Voting Score as the Instrument

	(1) OLS	(2) 2SLS	(3) Calories	(4) 2SLS	(5) A-B	(6) A-B_Cal
Log(Cereal Aid)$_{t-1}$	-0.0100**	-0.074**	-0.031*	-0.038*	-0.014*	-0.0067*
	(0.00453)	(0.0340)	(0.0177)	(0.0203)	(0.00806)	(0.00404)
Log(US Economic Aid)$_{t-2}$	-0.0013	0.017*	0.011	0.0091*	-0.00014	-0.00047
	(0.00231)	(0.00900)	(0.00789)	(0.00527)	(0.00159)	(0.00160)
Log(GDP per capita)$_{t-2}$	0.16**	-0.059	0.010	-0.048	0.051	0.056
	(0.0628)	(0.134)	(0.120)	(0.0675)	(0.0655)	(0.0637)
Log(Population)$_{t-1}$	0.97***	1.10***	1.09***	0.53***	0.45**	0.48**
	(0.227)	(0.194)	(0.190)	(0.114)	(0.212)	(0.214)
Deviation Precip	0.00017***	0.00013***	0.00014***	0.00012***	0.00016***	0.00016***
	(0.0000465)	(0.0000488)	(0.0000490)	(0.0000302)	(0.0000247)	(0.0000248)
Disasters$_{t-2}$	0.0048	0.0049	0.0043	0.0013	0.00093	0.00086
	(0.00423)	(0.00569)	(0.00545)	(0.00300)	(0.00299)	(0.00302)
Conflict$_{t-2}$	-0.051*	-0.074**	-0.072**	-0.044**	-0.0027	-0.00095
	(0.0294)	(0.0366)	(0.0340)	(0.0194)	(0.0173)	(0.0173)
Democracy Score$_{t-2}$	0.0089	0.0097	0.0076	0.0047	-0.0079**	-0.0078**
	(0.00655)	(0.00713)	(0.00676)	(0.00360)	(0.00383)	(0.00387)
Openness Score$_{t-2}$	-0.00035	-0.00030	-0.00031	-0.00010	0.00013	0.00011
	(0.000522)	(0.000475)	(0.000476)	(0.000264)	(0.000366)	(0.000370)
Arable Land$_{t-2}$	0.77	1.95**	1.80**	0.94*	-0.084	-0.11
	(0.652)	(0.852)	(0.818)	(0.500)	(0.559)	(0.565)
Log(Cereal Production)$_{t-1}$				0.53***	0.14**	0.161**
				(0.0678)	(0.0654)	(0.0635)
Kleibergen-Paap F-statistic		8.36	9.08	7.57		
Observations	3629	3531	3531	3531	3406	3406

Significance levels: * 10 percent, ** 5 percent, *** 1 percent. Standard errors (in parentheses) clustered by country. *Notes:* An observation is a country and a year. The sample includes 118 recipient countries from 1961–2006. All regressions include country fixed effects and year fixed effects.

Table A5: The 2SLS and Arellano-Bond Estimates when Varying the Lags of Stocks

	(1) 2SLS	(2) 2SLS	(3) A-B	(4) A-B
Log(Cereal Aid)$_{t-1}$	-0.071***	-0.065***	-0.015*	-0.016**
	(0.0196)	(0.0183)	(0.00808)	(0.00832)
Log(US Economic Aid)$_{t-2}$	0.016***	0.015***	-0.000077	-0.00011
	(0.00525)	(0.00498)	(0.00160)	(0.00164)
Log(GDP per capita)$_{t-2}$	-0.048	-0.021	0.052	0.058
	(0.0881)	(0.0833)	(0.0657)	(0.0664)
Log(Population)$_{t-1}$	1.09***	1.11***	0.45**	0.52**
	(0.197)	(0.203)	(0.212)	(0.215)
Deviation Precip	0.00013***	0.00014***	0.00016***	0.00017***
	(0.0000450)	(0.0000448)	(0.0000248)	(0.0000253)
Disasters$_{t-2}$	0.0049	0.0047	0.00093	0.0011
	(0.00564)	(0.00548)	(0.00300)	(0.00303)
Conflict$_{t-2}$	-0.073**	-0.071**	-0.0032	-0.0026
	(0.0358)	(0.0357)	(0.0173)	(0.0176)
Democracy Score$_{t-2}$	0.0096	0.0090	-0.0079**	-0.0083**
	(0.00721)	(0.00708)	(0.00384)	(0.00388)
Openness Score$_{t-2}$	-0.00030	-0.00018	0.00014	0.00020
	(0.000474)	(0.000491)	(0.000367)	(0.000377)
Arable Land$_{t-2}$	1.89***	1.73***	-0.057	-0.029
	(0.660)	(0.664)	(0.561)	(0.568)
Log(Cereal Production)$_{t-1}$			0.15**	0.16**
			(0.0653)	(0.0659)
Observations	3531	3470	3406	3345

Significance levels: * 10 percent, ** 5 percent, *** 1 percent. Standard errors (in parentheses) clustered by country. *Notes:* An observation is a country and a year. The sample includes 118 recipient countries from 1961–2006. All regressions include country fixed effects and year fixed effects. The first and third columns use log(military aid)$_{t-2}\times$voting$_{t-2}\times$wheat production$_{t-1}$ as the instrument. The second and fourth columns use log(military aid)$_{t-2}\times$voting$_{t-2}\times$wheat production$_{t-3}$ as the instrument.